region, but following different courses, and separated in time by from one-eighth to one-half of a second. But one flash, quite near to where I stood (one second and a half between flash and sound), gave a repetition following absolutely the same path as the first flash and practically as bright. The only difference was that two faint branches of the first flash were not repeated in the second discharge. The second flash followed so quickly (about an eighth of a second, I estimate), that the impression on the retina of the first discharge had not died out when the second exactly covered it, so that I could appreciate the absolute coincidence. A few kinematographic records of thunderstorms would show whether or not such repetitions are common, and whether they are the cause of dark flashes on the photographic plate.

Cave Castle, Dumbartonshire, N.B. J. B. HANNAY.

THE LAVOISIER MONUMENT.

THE monument erected by international subscription in honour of Lavoisier was unveiled on July 27, in the presence of M. Leygues, French Minister of Public Instruction, and many eminent men of science, including most of the members of the International Congress of Chemistry. The committee entrusted with the raising of the fund for the statue succeeded in obtaining a sum of 100,000 francs, which was subscribed by admirers of Lavoisier in most parts of the civilised world. M. Moissan was the secretary of the committee, and he acknowledged at the unveiling ceremony that there had not been the slightest difficulty in obtaining the means to erect the monument—many subscribers, indeed, were astonished to learn that Paris, where monuments abound, did not possess a statue of the eminent chemist whose investigations helped to lay the foundations of modern chemistry. It is true that appreciation of the great chemist has been shown by the publication of his complete works, but these are only known to a limited number of students, and the people who live in the present are likely to forget how much they owe to the past unless they are reminded of their indebtedness by some striking monument in bronze or stone. For this reason, it is well that a permanent memorial of Lavoisier's greatness has now been erected.

FIG. 1.—The statue of Lavoisier.

The statue, which is represented in the accompanying illustration from *La Nature*, is erected in the open space behind the Madeleine Church, close to the house where Lavoisier lived for some years. It is of bronze, and stands upon a granite pedestal ornamented with bas-reliefs. The statue is by M Barrais, and the pedestal is due to M. Gerhardt. Upon the front of the statue the following inscription appears, in French, "Antoine Laurent Lavoisier, 1743-1794, founder of modern chemistry. Erected by public subscription, under the patronage of the Academy of Sciences. M. Berthelot, Permanent Secretary of Physical Sciences, 1900." One of the bas-reliefs represents Lavoisier explaining his discovery of the composition of air to his colleagues of the Academy of Sciences, of which he was president, the characters introduced into the scene being Monge, Lagrange, Condorcet, Berthollet, Vicq d'Azyr, Laplace, Lamarc and Guyton de Morveau. On the other bas-relief Lavoisier is shown in his laboratory dictating notes to his wife. The statue appears to be a real work of art, worthy of the sculptor and of the subject.

M. Berthelot was to have presided at the ceremony of the unveiling, but illness prevented him from being present, and his address was read by M. Darboux.

Reference was made to the fact that the inauguration took place under the auspices of the Institute of France, the City of Paris and the French Government, and stress was laid upon the truly international character of the homage to the genius of Lavoisier, as testified by the subscriptions. The following is a free translation of parts of the address:—

The names of Galileo, Newton, Leibnitz and Lavoisier show that science has no nationality, a monopoly of pure or applied science being the property of no one nation. The erection of a statue in a public place is an honour usually reserved for statesmen and warriors, men who have spattered the earth with blood, too often without lasting profit to the nation devoted to them. To-day the famous savant, thinker, artist, is put in the first rank by enlightened people, and posterity will doubtless continue to show an increasing respect for the memory of those men who have served the human race, and to relegate to obscurity the men of blood and intrigue who have enslaved it.

The work of Lavoisier is epoch-making from two points of view, from that of philosophy, because he established the fundamental law which governs the chemical transformations of matter, and from the practical point of view, because this law has become the base of innumerable industries founded on these transformations, and the origin of the rules of hygiene and therapeutics which follow from it. The fundamental discovery of Lavoisier was the distinction between matter and the imponderable agents, such as heat, light, electricity, which influence it. The discovery of this distinction overthrew all the old ideas dating from antiquity, and which continued up to the end of the last century. According to the ideas which were current when Lavoisier started his work, there were four elements —earth, air, fire and water—from which all substances existing in nature were said to be built up. By associating these elements in different proportions and by different methods, it ought to be possible to produce all bodies and transform any one into any other. As a matter of fact, the prolonged researches of serious workers had never succeeded in establishing this transformation, nor has this been accomplished since. But preformed ideas are tenacious, especially when supported by mysticism.

An equally grave mistake was committed in supposing that bodies submitted to the influence of heat alone could vary in weight, a variation apparently proved by innumerable observations with the balance in chemistry. It is, in fact, a most singular error, although one frequently held, that the use of the balance in chemistry dates only from the end of the last century. In reality its use is sixteen centuries old. The balance was used both in chemistry and in trade; it may be seen represented on the monuments of ancient Egypt. Bodies such as coal, oils and organic substances under the action of heat were known to lose their weight, hence was drawn the conclusion that matter may be transformed into heat and disappear; whilst heat, on the other hand, under inverse conditions, could be fixed, becoming visible ponderable matter. These opinions gave way to the views of Stahl, according to whom combustible bodies were rich in phlogiston, or fixed heat. Such was the state of science about 1772, when Lavoisier appeared on the scene. Ten years were sufficient for him to effect a complete transformation. He established, by the most precise experiments, a fundamental distinction, previously unknown, between the nature of bodies which we know, and heat and other agents capable of modifying these; it is the distinction between ponderable bodies and the imponderable heat, light, electricity, the intervention of which causes no change of weight in ponderable matter.

It could hardly have been expected that one man alone should make all the researches establishing the properties of gases, the composition of air and of hot water, and in this respect there can be no doubt that Lavoisier profited by the partial work of his predecessors and of contemporary workers; but to him alone belongs the merit of demonstrating the connecting links, and of giving the facts their true interpretation.

Two fundamental problems were first attacked by Lavoisier, the gain in weight of metals on calcination, and the apparent loss of weight of carbon, sulphur and oils on combustion. His first discovery was to put these phenomena upon a proper experimental basis. He demonstrated that in all such cases a weighable substance contained in the air takes part in the change, the addition of which explains the increase of weight of the calcined metals, an increase equal to the loss of weight sustained by the air. The same ponderable element in the air was shown to take part in the burning of carbon, sulphur and oils, forming gaseous compounds, the weight of which was also determined by Lavoisier. It was thus established, what had never been done before, that the materials of bodies possessing weight kept this weight constant throughout a series of chemical changes, heat and other agents of the same order having no effect either in increasing or decreasing the weight of the original bodies. This fundamental distinction between ponderable matter and imponderable agents is one of the greatest discoveries that has ever been made; it lies at the base of physical, chemical and mechanical science. Lavoisier, however, went farther than this, and attempted to penetrate the constitution of ponderable matter itself. He recognised that in all known experiments it presents itself as constituted by a certain number of undecomposable elements or simple bodies, which, combining amongst themselves, form all known compounds.

The two fundamental laws of nature once established—the distinction between matter and imponderable agents, and the invariability of the nature and weight of the simple bodies—Lavoisier went on to draw important conclusions on the composition of the acids and metallic oxides, the composition of air, water and organic substances, on the *rôle* of heat in chemistry, on animal heat and on the nature of respiration in physiology.

What share ought to be now attributed to Lavoisier in the classical discovery of the compound nature of air and water, a discovery in which he competed with Priestley and Cavendish? The matter would take too long to give here in detail. Suffice it to say that he alone swept from the composition of air and water the erroneous notion of phlogiston maintained by his contemporaries.

All these discoveries, accumulated in the course of only a dozen years, and carried out with wonderful ardour and energy, were not simple proofs of isolated facts; on the contrary, they were the consequences logically deduced and experimentally demonstrated of the two fundamental laws due to the genius of Lavoisier. The physiological questions relating to respiration were also answered completely and successfully; given a correct knowledge of the elementary composition of carbonic acid, of food materials and of air, respiration was then obviously a slow combustion of food by the oxygen of the air, a combustion producing carbonic acid and developing at the same time sufficient heat to maintain the human body at a nearly constant temperature.

A complete account of the after effect of Lavoisier's work would require almost a history of physical science during the nineteenth century; but an attempt will be made to recapitulate the more immediate consequences upon existing knowledge. The notion of the invariability of the weights of the simple bodies dominates the whole of chemistry at the present time; it is the scientific basis of all our chemical equations of composition and constitution, the origin of the new and singular algebra which, from its origin in the works of Lavoisier, so struck the mathematicians of his time. It is also the solid foundation of all our analyses, and is a certain starting-point in industries the most diverse, the manufacture of acids, alkalis, colouring matters, scents, drugs, in metallurgy and in agriculture.

And here a necessary reflection occurs. It cannot be pretended that Lavoisier was the direct and personal author of the vast array of discoveries here enumerated; but it is certain that it is he who has established the solid base upon which the modern chemical edifice is constructed, and without which these discoveries could not have been made; it is he who has raised the flaming torch of truth which we daily invoke, and for that reason it is just and equitable to give to him a part of the glory of the inventions of science and modern industry.

NILE FLOODS AND MONSOON RAINS.

THE practice or science of weather forecasting will evidently proceed on two very different lines—according to the relative importance of local or seasonal changes in the general meteorological conditions, and whether the prediction has reference to a long or a short period. The machinery employed in cases where the forecast aims at great minuteness over a small area consists mainly of the synoptical chart, based on information supplied by rapid telegraphic communication, and in the hands of experts this means probably proves sufficient, and furnishes a fair percentage of accurate predictions. But in the more difficult, as certainly the more important, problem of predicting the weather some time in advance, and over a considerable area, a problem which regularly recurs in the monsoon forecast for India, one must evidently depend on the more general physical conditions that are produced by the motions of the earth and the distribution of land and water on its surface. These causes, it is true, are always operative, and to a certain extent meteorological phenomena, broadly considered, must be periodic in their main features. The causes of deviation from periodicity, and the extent of the area affected by such abnormal conditions, are problems which the professional meteorologist has to encounter, and it is to be feared with insufficient means. But it seems not unlikely that, in proportion as the problem becomes more general, by bringing wider areas within the scope of the discussion, the prospects of greater success will become more assured; and it cannot but be considered a most significant feature that indications are not wanting that in the two considerable areas, India and Egypt, the respective climates betray